

Limited Energy Study of Facilities in the Historic, Red Brick Main Post Area at Fort Bragg, North Carolina

Executive Summary

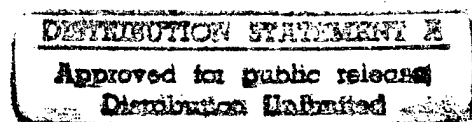
19971023 116

CONTRACT #DACA01-94-D-0034
DELIVERY ORDER 0005
SYSTEMS CORP PROJECT #94013.05

April 28, 1995



Savannah District-
US Army Corps
of Engineers



SYSTEMS*corp*

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION




DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

REPLY TO
ATTENTION OF:

TR-I Library

17 Sep 1997

Based on SOW, these Energy Studies are unclassified/unlimited.
Distribution A. Approved for public release.


Marie Wakefield,
Librarian Engineering

United Energy Study of Facilities
Historic Red Brick Main Post Area
Fort Bragg, North Carolina

First Year Savings (\$1000) \$ 349

Energy Savings ($\frac{MBTU}{yr}$) 16,577

TABLE OF CONTENTS

LIMITED ENERGY STUDY OF HISTORIC RED BRICK AREA, FT. BRAGG, NC

TABLE OF CONTENTS

1	EXECUTIVE SUMMARY	1-1
1.1	SUMMARY RESULTS	1-2
1.2	RECOMMENDED PROJECTS AND ORGANIZATION	1-3

TABLES

<i>Table 1.1.1</i>	All ECOs From Highest to Lowest SIR	1-5
<i>Table 1.1.2</i>	Recommended ECOs From Highest to Lowest SIR	1-8
<i>Table 1.1.3</i>	Non-recommended ECOs From Highest to Lowest SIR	1-10
<i>Table 1.1.4</i>	Recommended ECOs Sorted by Building Number	1-12
<i>Table 1.1.5</i>	Project Results by ECO	1-14

1 EXECUTIVE SUMMARY

LIMITED ENERGY STUDY OF HISTORIC RED BRICK AREA, FT. BRAGG, NC

This document has been prepared to provide a prefinal of the progress made on the project to date. It also provides information required to identify projects for programming and preparation of necessary funding documentation. The projects are formed by grouping energy conservation opportunities (ECOs) for the buildings into packages which meet specific funding criteria. Your timely review and comments on this document are critical to the successful and timely completion of the project. To assist you in expediting this process, we have included in this section several copies of a reviewer's comment form. Use of this form will assure all information needed to properly respond to your comments is available. Please forward your comments to the following address as soon as possible, but no more than twenty-one days after you receive this report:

Savannah District, Corps of Engineers

Attn: CESAS-PM-MP (Mr. Rob Callahan)

100 W. Oglethorpe Avenue

P.O. Box 889

Savannah, GA 31402-0889

Feel free to copy as many comment pages as you wish.

1 EXECUTIVE SUMMARY

LIMITED ENERGY STUDY OF HISTORIC RED BRICK AREA, FT. BRAGG, NC

1.1 SUMMARY RESULTS

This analysis involved 12 buildings located in the Historic Red Brick Area of Fort Bragg. The buildings were all constructed in the 1910-30 time frame. All are currently heated by oil-fired boilers and all have central cooling to a large extent, with the exception of Building 2-1549 which is a high bay shop facility. All buildings are office type facilities utilizing fluorescent fixtures with the exception of Shop 2-1549 which has mercury vapor fixtures.

Seven specific energy conservation opportunities (ECOs) were analyzed for this report:

- ECO-1: Install High Efficiency Lighting Systems
- ECO-2: Building Envelope Modifications
- ECO-3: Water Conservation Improvements
- ECO-4: Install New Gas Heating Systems
- ECO-5: Install New Oil Heating Systems
- ECO-6: Renovate HVAC Systems
- ECO-7: Install Central Chilled Water Plant

ECO-1 incorporates changing from T-12 fluorescent to T-8 fluorescent fixtures; replacing incandescents with compact fluorescents; replacing mercury vapors with metal halide or high pressure sodium and retrofitting incandescent exit sign lamps with LED lamps.

The analyses for ECO-1 were performed on a building-by-building basis, and only Building 1-1434 resulted in a payback of less than ten years and a savings-to-investment ratio (SIR) of greater than 1:25. Specific areas were then analyzed as sub-ECOs to try to generate lighting projects. All feasible lighting opportunities were then grouped together for one project which has an investment cost of \$419,500 with a payback of 5.6 years and an SIR of 1.5.

ECO-2 evaluates replacing existing windows with double-paned, argon-filled, solar-tinted windows; weatherstripping and caulking; and adding roof and crawl space insulation. These measures could not be recommended since none had a payback or SIR which resulted in project qualification.

ECO-3 is the installation of water-saving flush valves on toilets and urinals, water-saving showerheads and spring-loaded faucets on lavatory sinks. All of these measures are recommended in every building and result in the quickest payback on the total investment of \$101,301 at two years with an SIR of 9.0.

1 EXECUTIVE SUMMARY

LIMITED ENERGY STUDY OF HISTORIC RED BRICK AREA, FT. BRAGG, NC

~~ECO-4~~ is the replacement of existing oil-fired boilers with natural gas boilers. For this installation, the nearby gas main is extended to serve all twelve of the buildings. The boiler replacement is recommended for all but two buildings, 1-1434 and 2-1105, which have new dual-fuel boilers. The ECO has an overall simple payback on the total project investment of \$376,059 at 5.1 years with an SIR of 3.6.

~~ECO-5~~ is the same as ECO-4 except that oil-fired boilers are used instead of natural gas to replace existing boilers. Only Building 2-1549 qualifies for funding under this ECO. However, this ECO is not recommended since ECO-4 and ECO-5 are mutually exclusive, and ECO-4 is preferred.

ECO-6 is the renovation of existing HVAC systems to install more efficient systems. Where central systems already exist, they were replaced with more efficient variable air volume (VAV) systems. Where no central system exists, new VAV systems were simulated. Where chilled water systems are in use, new chiller installations are proposed. Five buildings qualified for funding, all with paybacks in the area of nine years and SIRs of 1.7. The project cost for the five qualifying buildings is \$1,121,951.

~~ECO-7~~ is the installation of an area central chilled water plant to serve the nine buildings of the twelve under analysis which use chilled water for cooling. The simple payback of 31 years and an SIR of 0.5 ruled out this project.

1.2 RECOMMENDED PROJECTS AND ORGANIZATION

A considerable amount of data has been generated as a result of this study to date. There is a wide variety of ways to present the data. Systems Corp has presented the data in five tables to provide the installation with different viewpoints. The first table (*Table 1.1.1*) simply lists all of the ECOs in order from highest to lowest savings-to-investment ratio (SIR), in accordance with the Scope of Work. In addition, we have presented four other listings which should give the installation a clearer choice of project groupings.

The second listing is *Table 1.1.2*. We have listed only those ECOs recommended for consideration. Projects can only be recommended if the SIR is greater than 1.25 and the simple payback is ten years or less.

The third listing is *Table 1.1.3*. We have listed only those ECOs not recommended for implementation. If the simple payback is greater than ten years or the SIR is less than 1.25, the ECO is not recommended.

The fourth listing is *Table 1.1.4*. This table lists the recommended ECOs by building. This presentation indicates the work required in each building if all ECOs are implemented. The listing also totals the

1 EXECUTIVE SUMMARY

LIMITED ENERGY STUDY OF HISTORIC RED BRICK AREA, FT. BRAGG, NC

investment costs and the first year savings. We have purposely provided only relevant information in these tables, omitting other data which is available in many locations throughout this report.

The fifth listing is *Table 1.1.5*, which presents the total SIR and simple payback if all ECOs evaluated are implemented. A grand total SIR and simple payback was computed totaling all buildings and ECOs.

The logical grouping for projects is by ECO. That is, combine all the recommended lighting projects (ECO-1) into one group, natural gas improvements (ECO-4) into one group, and HVAC improvements (ECO-6) into one project grouping.

TABLE 1.1.1
ALL ECOs FROM
HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
3	All Bldgs.	\$101,301	\$50,451	2.01	9.01	14.97%
4	1-1326	\$34,171	\$11,074	3.09	5.92	12.58%
4	2-1120	\$34,171	\$10,387	3.29	5.55	12.22%
4	2-1138	\$29,438	\$8,588	3.43	5.31	11.97%
1.6	2-1133	\$1,590	\$882	1.80	4.74	—
1.6	2-1138	\$2,120	\$1,176	1.80	4.74	—
1.6	2-1127	\$177	\$98	1.81	4.72	—
4	2-1127	\$36,117	\$7,852	4.60	3.95	10.32%
4	2-1728	\$34,171	\$7,017	4.87	3.72	9.99%
1.6	2-1120	\$2,686	\$1,020	2.63	3.25	—
4	2-1549	\$96,619	\$14,612	6.48	2.81	8.47%
4	2-1731	\$34,171	\$5,000	6.83	2.64	8.11%
4	1-1333	\$18,537	\$2,767	6.70	2.61	8.05%
4	1-1242	\$26,493	\$3,633	7.29	2.43	7.68%
5	2-1549	\$88,073	\$10,568	8.33	2.19	7.11%
1.6	1-1434	\$26,634	\$6,405	4.16	2.06	—
4	2-1133	\$34,171	\$3,815	8.96	1.98	6.59%
6	2-1105	\$277,362	\$30,942	8.96	1.92	6.42%
1.6	2-1105	\$8,377	\$1,826	4.59	1.87	—
6	1-1242	\$75,684	\$8,187	9.24	1.79	6.04%
6	2-1728	\$268,956	\$28,653	9.39	1.77	5.97%
1.6	1-1242	\$4,628	\$907	5.10	1.68	—
1.6	2-1731	\$10,074	\$1,924	5.24	1.64	—

TABLE 1.1.1
ALL ECOs FROM
HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
1.1	2-1549	\$53,693	\$10,238	5.24	1.63	—
6	1-1326	\$431,912	\$43,769	9.87	1.61	5.50%
1.1	1-1326	\$20,994	\$3,862	5.44	1.58	—
1.1	2-1127	\$54,358	\$9,873	5.51	1.56	—
6	2-1127	\$68,037	\$6,905	9.85	1.51	—
1.1	2-1120	\$90,385	\$14,702	6.15	1.39	—
6	2-1549	\$30,930	\$2,793	11.07	1.35	—
1.3	2-1728	\$50,955	\$7,750	6.58	1.30	—
1.1	2-1105	\$9,300	\$1,408	6.61	1.30	—
1.1	2-1133	\$80,849	\$12,116	6.67	1.29	—
1.5	2-1120	\$2,731	\$403	6.78	1.27	—
1.2	2-1120	\$18,245	\$2,645	6.90	1.24	—
1.1	2-1731	\$34,796	\$4,981	6.99	1.23	—
1.1	2-1138	\$35,269	\$5,051	6.98	1.23	—
1.4	1-1242	\$2,210	\$307	7.21	1.19	—
1.2	2-1105	\$7,733	\$1,053	7.35	1.17	—
1.2	1-1242	\$10,675	\$1,457	7.33	1.17	—
1.2	2-1731	\$21,645	\$2,906	7.45	1.15	—
5	1-1326	\$41,849	\$2,693	15.54	1.15	3.73%
5	2-1138	\$32,277	\$2,155	15.44	1.15	3.71%
6	1-1333	\$77,123	\$5,904	13.06	1.13	—
1.2	2-1138	\$32,773	\$4,298	7.62	1.13	—
6	2-1120	\$90,099	\$6,766	13.32	1.12	—

TABLE 1.1.1
ALL ECOs FROM
HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
6	2-1138	\$268,956	\$18,593	14.47	1.10	—
5	2-1120	\$41,849	\$2,547	16.43	1.09	3.43%
6	2-1731	\$78,102	\$5,670	13.77	1.09	—
1.1	1-1242	\$7,528	\$906	8.31	1.03	—
2	1-1333	\$50,637	\$2,662	19.02	0.90	2.43%
2	2-1127	\$184,345	\$9,157	20.13	0.86	2.22%
5	1-1333	\$17,314	\$885	19.56	0.84	—
5	2-1728	\$41,849	\$1,812	23.09	0.76	1.60%
5	2-1127	\$47,849	\$1,995	23.91	0.74	1.45%
2	1-1242	\$69,529	\$2,909	23.90	0.74	1.49%
1.1	1-1333	\$29,702	\$2,474	12.01	0.71	—
2	2-1133	\$166,318	\$6,522	25.50	0.66	0.88%
5	2-1731	\$41,849	\$1,486	28.16	0.62	—
5	1-1242	\$33,277	\$1,074	30.98	0.54	—
7	—	\$1,419,763	\$45,543	31.17	0.48	—
5	2-1133	\$41,849	\$1,114	37.57	0.45	—
2	1-1326	\$238,899	\$5,496	43.47	0.38	-1.83%
2	2-1138	\$287,747	\$5,821	49.43	0.35	-2.33%
2	2-1549	\$256,395	\$4,563	56.19	0.33	-2.56%
2	2-1731	\$316,902	\$6,293	50.36	0.32	-2.66%
2	2-1105	\$411,023	\$7,554	54.41	0.31	-2.90%
2	2-1120	\$295,688	\$4,912	60.20	0.29	-3.19%
2	2-1728	\$306,474	\$5,280	58.05	0.28	-3.29%

TABLE 1.1.2
RECOMMENDED ECOs FROM
HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
3/WATER	ALL BLDGS	\$101,301	\$50,451	2.01	9.01	14.97%
4/NGHTG	1-1326	\$34,171	\$11,074	3.09	5.92	12.58%
4/NGHTG	2-1120	\$34,171	\$10,387	3.29	5.55	12.22%
4/NGHTG	2-1138	\$29,438	\$8,588	3.43	5.31	11.97%
1.6/LIGHT	2-1133	\$1,590	\$882	1.80	4.74	—
1.6/LIGHT	2-1138	\$2,120	\$1,176	1.80	4.74	—
1.6/LIGHT	2-1127	\$177	\$98	1.81	4.72	—
4/NGHTW	2-1127	\$36,117	\$7,852	4.60	3.95	10.32%
4/NGHTG	2-1728	\$34,171	\$7,017	4.87	3.72	9.99%
1.6/LIGHT	2-1120	\$2,686	\$1,020	2.63	3.25	—
4/NGHTG	2-1549	\$96,619	\$14,612	6.48	2.81	8.47%
4/NGHTG	2-1731	\$34,171	\$5,000	6.83	2.64	8.11%
4/NGHTG	1-1333	\$18,537	\$2,767	6.70	2.61	8.05%
4/NGHTG	1-1242	\$26,493	\$3,633	7.29	2.43	7.68%
1.6/LIGHT	1-1434	\$26,634	\$6,405	4.16	2.06	—
4/NGHTG	2-1133	\$34,171	\$3,815	8.96	1.98	6.59%
6/HVAC	2-1105	\$277,362	\$30,942	8.96	1.92	6.42%
1.6/LIGHT	2-1105	\$8,377	\$1,826	4.59	1.87	—
6/HVAC	1-1242	\$75,684	\$8,187	9.24	1.79	6.04%
6/HVAC	2-1728	\$268,956	\$28,653	9.39	1.77	5.97%
1.6/LIGHT	1-1242	\$4,628	\$907	5.10	1.68	—
1.6/LIGHT	2-1731	\$10,074	\$1,924	5.24	1.64	—

TABLE 1.1.2
RECOMMENDED ECOs FROM
HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
1.1/LIGHT	2-1549	\$53,693	\$10,238	5.24	1.63	—
6/HVAC	1-1326	\$431,912	\$43,769	9.87	1.61	5.50%
1.1/LIGHT	1-1326	\$20,994	\$3,862	5.44	1.58	—
1.1/LIGHT	2-1127	\$54,358	\$9,873	5.51	1.56	—
6/HVAC	2-1127	\$68,037	\$6,905	9.85	1.51	—
1.1/LIGHT	2-1120	\$90,385	\$14,702	6.15	1.39	—
1.3/LIGHT	2-1728	\$50,955	\$7,750	6.58	1.30	—
1.1/LIGHT	2-1105	\$9,300	\$1,408	6.61	1.30	—
1.1/LIGHT	2-1133	\$80,849	\$12,116	6.67	1.29	—
1.5/LIGHT	2-1120	\$2,731	\$403	6.78	1.27	—
1.2/LIGHT	2-1120	\$18,245	\$2,645	6.90	1.24	—
1.1/LIGHT	2-1138	\$35,269	\$5,051	6.98	1.23	—
1.1/LIGHT	2-1731	\$34,796	\$4,981	6.99	1.23	—

TABLE 1.1.3
NON-RECOMMENDED ECOs
FROM
HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
5	2-1549	\$88,073	\$10,568	8.33	2.19	7.11%
6	1-1242	\$82,981	\$8,187	10.14	1.63	5.55%
6	2-1127	\$69,470	\$69,005	10.06	1.48	—
6	2-1549	\$30,930	\$2,793	11.07	1.35	—
1.4	1-1242	\$2,210	\$307	7.21	1.19	—
1.2	1-1242	\$10,675	\$1,457	7.33	1.17	—
1.2	2-1105	\$7,733	\$1,053	7.35	1.17	—
1.2	2-1731	\$21,645	\$2,906	7.45	1.15	—
5	1-1326	\$41,849	\$2,693	15.54	1.15	3.73%
5	2-1138	\$32,277	\$2,155	15.44	1.15	3.71%
1.2	2-1138	\$32,773	\$4,298	7.62	1.13	—
6	1-1333	\$77,123	\$5,904	13.06	1.13	—
6	2-1120	\$90,099	\$6,766	13.32	1.12	—
6	2-1138	\$268,956	\$18,593	14.47	1.10	—
5	2-1120	\$41,849	\$2,547	16.43	1.09	3.43%
6	2-1731	\$78,102	\$5,670	13.77	1.09	—
1.1	1-1242	\$7,528	\$906	8.31	1.03	—
2	1-1333	\$50,637	\$2,662	19.02	0.90	2.43%
2	2-1127	\$184,345	\$9,157	20.13	0.86	2.22%
5	1-1333	\$17,314	\$885	19.56	0.84	—
5	2-1728	\$41,849	\$1,812	23.09	0.76	1.60%
5	2-1127	\$47,849	\$1,995	23.91	0.74	1.45%
2	1-1242	\$69,529	\$2,909	23.90	0.74	1.49%

TABLE 1.1.3
NON-RECOMMENDED ECOs
FROM
HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
1.1	2-1333	\$29,702	\$2,474	12.01	0.71	—
2	2-1133	\$166,318	\$6,522	25.50	0.66	0.88%
5	2-1731	\$41,849	\$1,486	28.16	0.62	—
5	1-1242	\$33,277	\$1,074	30.98	0.54	—
7	—	\$1,419,763	\$45,543	31.17	0.48	—
5	2-1133	\$41,849	\$1,114	37.57	0.45	—
2	1-1326	\$238,899	\$5,496	43.47	0.38	-1.83%
2	2-1138	\$287,747	\$5,821	49.43	0.35	-2.33%
2	2-1549	\$256,395	\$4,563	56.19	0.33	-2.56%
2	2-1731	\$316,902	\$6,293	50.36	0.32	-2.66%
2	2-1105	\$411,023	\$7,554	54.41	0.31	-2.90%
2	2-1120	\$295,688	\$4,912	60.20	0.29	-3.19%
2	2-1728	\$306,474	\$5,280	58.05	0.28	-3.29%

TABLE 1.1.4

**RECOMMENDED ECOs SORTED
BY BUILDING NUMBER**

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
4/NGHTG	1-1242	\$26,493	\$3,633	7.29	2.43	7.68%
1.6/LIGHT	1-1242	\$4,628	\$907	5.10	1.68	—
6/HVAC	1-1242	\$75,684	\$8,187	9.24	1.79	6.04%
4/NGHTG	1-1326	\$34,171	\$11,074	3.09	5.92	12.58%
6/HVAC	1-1326	\$431,912	\$43,769	9.87	1.61	5.50%
4/NGHTG	1-1333	\$18,537	\$2,767	6.70	2.61	8.05%
1.6/LIGHT	1-1434	\$26,634	\$6,405	4.16	2.06	—
1.1/LIGHT	2-1105	\$9,300	\$1,408	6.61	1.30	—
1.6/LIGHT	2-1105	\$8,377	\$1,826	4.59	1.87	—
6/HVAC	2-1105	\$277,362	\$30,942	8.96	1.92	6.42%
4/NGHTG	2-1120	\$34,171	\$10,387	3.29	5.55	12.22%
1.6/LIGHT	2-1120	\$2,686	\$1,020	2.63	3.25	—
1.5/LIGHT	2-1120	\$2,731	\$403	6.78	1.27	—
1.1/LIGHT	2-1120	\$90,385	\$14,702	6.15	1.39	—
4/NGHTG	2-1127	\$36,117	\$7,852	4.60	3.95	10.32%
6/HVAC	2-1127	\$68,037	\$6,905	9.85	1.51	—
1.6/LIGHT	2-1127	\$177	\$98	1.81	4.72	—
1.1/LIGHT	2-1127	\$54,358	\$9,873	5.51	1.56	—
4/NGHTG	2-1133	\$34,171	\$3,815	8.96	1.98	6.59%
1.1/LIGHT	2-1133	\$80,849	\$12,116	6.67	1.29	—
1.6/LIGHT	2-1133	\$1,590	\$882	1.80	4.74	—
1.6/LIGHT	2-1138	\$2,120	\$1,176	1.80	4.74	—

TABLE 1.1.4**RECOMMENDED ECOs SORTED
BY BUILDING NUMBER**

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
4/NGHTG	2-1138	\$29,438	\$8,588	3.43	5.31	11.97%
1.1/LIGHT	2-1326	\$20,994	\$3,862	5.44	1.58	—
4/NGHTG	2-1549	\$96,619	\$14,612	6.48	2.81	8.47%
1.1/LIGHT	2-1549	\$53,693	\$10,238	5.24	1.63	—
6/HVAC	2-1728	\$268,956	\$28,653	9.39	1.77	5.97%
4/NGHTG	2-1728	\$34,171	\$7,017	4.87	3.72	9.99%
1.3/LIGHT	2-1728	\$50,955	\$7,750	6.58	1.30	—
1.6/LIGHT	2-1731	\$10,074	\$1,924	5.24	1.64	—
4/NGHTG	2-1731	\$34,171	\$5,000	6.83	2.64	8.11%
3/WATER	ALL BLDGS	\$101,301	\$50,451	2.01	9.01	14.97%

TABLE 1.1.5
RECOMMENDED PROJECT RESULTS BY ECO

ECO NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
ECO-1	\$419,550	\$74,590	5.62	1.52	7.44%
ECO-3	\$101,301	\$50,451	2.01	9.01	14.97%
ECO-4	\$378,059	\$74,311	5.09	3.57	9.76%
ECO-6	\$1,121,951	\$118,456	9.47	1.77	6.02%